TIRE WITH REINFORCEMENT STRUCTURE IN THE FORM OF GROUPS

The present invention relates to tires. More particularly, it relates to the arrangement and the configuration of the reinforcement structure in the sidewalls, the beads and the crown zone of the tire; it also relates to the anchoring of the carcass cords in the bead and the reinforcements of different portions of the bead or the sidewall.

The carcass reinforcement of tires is currently constituted by one or more plies, most frequently radial ones, which are turned up about one or more bead wires arranged in the beads. The beads constitute the means which makes it possible to fix the tire on the rim. The rigidity of the bead thus constituted is very great.

For some specific applications in which the tire may for example be subjected to greater loads or to more violent impacts, etc., it may prove desirable to be able to refine some characteristics such as rigidity, impact strength, etc. Furthermore, in order to facilitate automation of certain steps of the tire manufacturing process, it may prove advantageous to revise the nature and/or the arrangement of some of the constituent elements.

In the current art, it is quite difficult to modulate the characteristics of the sidewall and/or of the bead. The sidewall must have great flexibility, and the bead, in contrast, must have great rigidity. Furthermore, the reinforcements which are arranged in this part of the tire always inevitably have a discontinuity: at the level of the radially upper end of the carcass upturn, there is a change without transition into a zone devoid of this carcass upturn, which zone is therefore inevitably less rigid.

Finally, the cost demands are becoming increasingly harsh and require productivity gains which are becoming increasingly difficult to obtain, taking into account the ceaselessly increasing technicality of the products. Any method or device which makes it possible to produce tires at faster rates while maintaining the level of quality are therefore potentially advantageous.

In order to make allowance for this environment and these constraints, the invention provides a tire comprising at least one reinforcement structure of carcass type anchored on either side of the tire in a bead the base of which is intended to be mounted on a rim seat, a crown reinforcement, each bead being extended radially towards the outside by a sidewall, the sidewalls joining a tread radially towards the outside, the reinforcement structure comprising:

- a first filament forming on one hand at the level of the crown and the sidewalls a series of transverse portions extending substantially from one bead of the tire to the other, and on the other hand, at the level of the beads, U-shaped connections joining two successive transverse portions of the first filament,
- a second filament forming on one hand at the level of the crown and the sidewalls a series of transverse portions extending substantially from one bead of the tire to the other, and on the other hand, at the level of the beads, U-shaped connections joining two successive transverse portions of the second filament,
- the respective paths of the first and second filaments being arranged such that, between the crown and the bead, a group of filaments formed by a first and a second adjacent (or successive) filament forms at least a portion of substantially parallel paths.

Such an arrangement comprising substantially parallel groups of filaments makes it possible to produce a multifilament configuration very economically. The groups of cords may be applied substantially simultaneously, for example by means of a single laying head. In this manner, and due to the specific type of architecture according to the invention, it is possible to divide by two or even by three or more the time for laying the reinforcement filaments of carcass type, in particular if the production is effected on a central core preformed in the image of a tire.

Furthermore, the arrangement in substantially parallel groups makes it possible to arrange the filaments very close to one another, thus contributing to increasing the cord density. This has a beneficial effect on a good number of mechanical properties. Thus for example, it may make it possible to increase the modulus, the tensile strength, etc.

Advantageously, the portions of substantially parallel paths represent at least substantially 25% of the total path of the filaments between the crown and the anchoring zone and preferably between substantially 30% and 80% of the total path of the filaments between the crown and the anchoring zone.

Insofar as the cords are laid in pairs or any other grouped form, the laying time is reduced, thus reducing the cost price.

Advantageously, the portions of substantially parallel paths are provided in the sidewall, substantially radially externally to the anchoring zone, and preferably radially externally to the zone corresponding substantially to the equator of said sidewall. The laying in the form of parallel groups is easiest and most precise structurally starting from the equator and moving towards the crown. Preferably, the equator in question is the one corresponding to the equator of the core on which the different constituent elements of the tire are assembled.

According to another advantageous example, the tire comprises a third filament forming on one hand, at the level of the crown and the sidewalls, a series of transverse portions extending substantially from one bead of the tire to the other, and on the other hand, at the level of the beads, U-shaped connections joining two successive transverse portions of the third filament, the respective paths of the first, second and third filaments being arranged such that, between the crown and the bead, a group of filaments formed by a first, a second and a third adjacent (or successive) filament form at least a portion of substantially parallel paths.

The laying time can then be divided by three if the cords are laid in groups. The laying density may also be increased, by substantially similar, close paths of the cords of one and the same group.

At least one arrangement of cords along a substantially circumferential path is preferably arranged substantially adjacent to said reinforcement structure at the level of the bead.

According to another advantageous example, the portions of substantially parallel paths follow substantially geodesic trajectories, either radial or non-radial.

According to another advantageous embodiment, the "forward" and "return" sections of at least two distinct groups cross so as to form a mesh pattern of cords. For example, the portions of substantially parallel path are arranged so as to form, on a given side of the tire, a trajectory in the form of circumferentially offset forward and return paths. Said trajectory is advantageously V- or U-shaped. One of the forward or return portions runs along the other forward or return portion of a series of juxtaposed filaments, crossing the filaments. The result of such a configuration is braiding of filaments, crossing at angles which are more or less open according to the radial position and/or according to the respective inclination of each of the filaments.

The tire may then comprise a single ply. A simple architecture and manufacture of this type, due in particular to the reduction in the number of constituents, makes it possible to reduce the costs.

The present invention also provides a tire comprising at least one reinforcement structure of carcass type anchored on either side of the tire in a bead, the base of which is intended to be mounted on a rim seat, a crown reinforcement, each bead being extended radially towards the outside by a sidewall, the sidewalls joining a tread radially towards the outside, the reinforcement structure comprising:

- a first filament forming on one hand at the level of the crown and the sidewalls a series of transverse portions extending substantially from one bead of the tire to the other, and on the other hand, at the level of the beads, U-shaped connections joining two successive transverse portions of the first filament,
- a second filament forming at the level of the crown and the sidewalls a series of transverse portions extending substantially from one bead of the tire to the other, comprising free ends being arranged on either side of the tire in the zone of each of the beads,
- the respective paths of the first and second filaments being arranged such that, between the crown and the bead, a group of filaments formed by a first and a

second adjacent (or successive) filament forms at least a portion of substantially parallel paths.

According to another advantageous example of embodiment, a bead comprises a bead wire around which a portion of the cords is wound. This provides effective and reliable anchoring or holding of the reinforcement structure in the bead. This method of anchoring corresponds to a traditional bead wire, widespread in the tire industry. Preferably cords of textile type are used in order to facilitate the formation of the loops.

Advantageously, the tire according to the invention may be manufactured by means of a process for manufacturing a tire in which the different constituent elements are laid turn by turn directly on a core which is for example substantially rigid or inflatable, the profile of which corresponds substantially to that of the final product.

In the case of a tire manufactured using such an automated process in which the different constituent elements are laid turn by turn directly on a core, the profile of which corresponds substantially to that of the final product, the fact of laying groups of cords comprising two (or more) cords is particularly advantageous. For example, the result is a great reduction in the laying time for the reinforcement structure.

In the present specification, the term "cord" very generally designates both monofilaments and multifilaments, or assemblies such as cables, plied yarns or alternatively any equivalent type of assembly, and this whatever the material and the treatment of these cords, for example surface treatment or coating or pre-sizing in order to promote adhesion to the rubber, be it treatment before or after the cords are laid.

As a reminder, "radially upwards" or "radially upper" means towards the largest radii.

"Elasticity modulus" of a rubber mix is understood to mean a secant modulus of extension obtained at a uniaxial deformation of extension of the order of 10% at ambient temperature.

A reinforcement or reinforcing structure of carcass type will be said to be radial when its cords are arranged at 90°, but also, according to the terminology in use, at an angle close to 90°.

It is known that in the current art the carcass ply or plies is/are turned up about a bead wire. The bead wire then performs the function of anchoring the carcass, that is to say, takes up the tension which develops in the carcass cords under the action of the inflation pressure. In the configurations described in the present application, which do not use a bead wire of conventional type, the function of anchoring the reinforcement structure of carcass type is also ensured.

It is also known, still in the prior art, that the same bead wire furthermore performs a function of clamping the bead on its rim. In the configurations described in the present application, which preferably do not use a bead wire of conventional type, the clamping function is also ensured, in particular by the windings of circumferential cords closest to the seat.

It goes without saying that the invention can be used by adding other elements to the bead or to the bottom zone of the tire in general, as some variants will illustrate. Likewise, the invention can be used by multiplying the reinforcement structures of the same type, or even by adding another type of reinforcement structure.

All the details of embodiment are given in the following description, supplemented by Figures 1 to 13, in which:

Figures 1a and 1b are radial sections showing essentially the sidewalls, the beads and the crown of a first and a second form of embodiment of a tire according to the invention;

Figure 2 is a diagrammatic representation, viewed from above, of a portion of the reinforcement structure of an example of a tire according to the invention, the two sidewalls being placed flat on each side of the region of the crown;

Figure 3 is a diagrammatic representation, viewed from above, of a portion of the reinforcement structure of another example of a tire according to the invention, the two sidewalls being placed flat on each side of the region of the crown;

Figure 4 is a diagrammatic representation, viewed from above, of a portion of the reinforcement structure of another example of a tire according to the invention, the two sidewalls being placed flat on each side of the region of the crown;

Figure 5 is an enlarged view of the left-hand portion of Figure 4;

Figure 6 is a diagrammatic representation, viewed from above, of a portion of the reinforcement structure of a tire according to the invention, the two sidewalls being placed flat on each side of the region of the crown;

Figure 7 is an enlarged view of the left-hand portion of Figure 6;

Figure 8 is a side view of a portion of a non-finished tire according to the invention, in which groups comprising three cords are arranged along paths of bias type;

Figure 9 is a side view of a portion of a non-finished tire according to the invention, in which groups comprising three cords are arranged along paths of symmetrical-bias type, in which the "forward" sections are symmetrical and inverted relative to the "return" sections, the multiplication of the groups thus involving an arrangement in the form of a braided or mesh pattern of cords;

Figure 10a is a side view of a portion of a non-finished tire according to the invention, in which groups are arranged along paths of geodesic type;

Figures 11a, 11b and 11c are meridian profiles of a variant comprising a conventional bead wire, for example formed of a metal or composite cable;

Figures 12a, 12b and 12c illustrate, by means of perspective views of a section of a portion of a tire according to the invention, examples of paths of a reinforcement structure in groups in relation to a circumferential anchoring structure;

Figures 13a to 13d illustrate an example of a method which permits the manufacture of tires such as those described in the preceding figures, with the substantially simultaneous laying of at least two cords.

In the different figures, identical reference numerals are used in order to identify similar elements.

Figures 1a, 1b and 2 illustrate a first embodiment of the tire 1 according to the invention. The main constituent elements are clearly visible in Figures 1a and 1b, which show a section showing the profile of the tire 1. This comprises sidewalls 3, on each side, surmounted by a crown 2, joining the two radially upper portions of the sidewalls 3.

In the radially inner portion of the sidewalls 3, there are located beads 4, provided for mounting on a rim of suitable form and dimensions.

In order to ensure perfect anchoring of the reinforcement structure, preferably a stratified composite bead is produced. Within the bead 4, between the cord alignments of the reinforcement structure, there are arranged circumferentially oriented cords 60. These are arranged in a stack 61 as in the drawings, or in a plurality of adjacent stacks, or in packets, or in any suitable arrangement, depending on the type of tire and/or the desired characteristics.

The radially inner end portions of the reinforcement structure 5 cooperate with the beads. There is thus created anchoring of these portions in said beads so as to ensure the integrity of the tire. In order to promote this anchoring, the space

between the circumferential cords and the reinforcement structure is occupied by a bonding rubber mix. It is also possible to provide for the use of a plurality of mixes having different characteristics, defining a plurality of zones, the combinations of mixes and the resultant arrangements being virtually unlimited. However, it is advantageous to provide for the presence of a mix of high elasticity modulus in the zone of intersection between the arrangement of cords and the reinforcement structure. By way of non-limitative example, the elasticity modulus of such a mix may reach or even exceed 15 to 25 MPa, and even in some cases reach or even exceed 40 MPa.

This mix of high modulus is advantageously arranged so as to be in direct contact with the adjacent portions of the reinforcement structure 5. In the conventional configurations, a carcass ply (cord impregnated in a layer of rubber mix) is applied. There therefore results a thin intermediate layer of mix of lower modulus which is located between the mix of high modulus and the portion of reinforcement structure. With direct contact, and therefore without the presence of this thin layer of mix of lower modulus, the impact of the presence of the mix of high modulus in the zone is amplified. In fact, the traditional thin layer of lower modulus causes losses of energy, which may cause deterioration of the mechanical properties.

The arrangements of cords may be arranged and manufactured in several ways. For example, a stack 61 may advantageously be formed of a single cord wound (substantially at zero degrees) in a spiral over several turns, preferably from the smallest diameter towards the largest diameter. A stack may also be formed of a plurality of concentric cords laid one in another, so that rings of gradually increasing diameter are superposed. It is not necessary to add a rubber mix to impregnate of the reinforcement cord, or circumferential windings of cord.

In order to position the reinforcement cords as accurately as possible, it is very advantageous to build the tire on a rigid support, for example a rigid core which imposes the shape of its inner cavity. There are applied to this core, in the order required by the final architecture, all the constituents of the tire, which are arranged directly in their final position, without the profile of the tire having to be

turned up or folded over during building. This building may for example use the devices described in Patent EP 0 580 055, and also in French application 00/01394, for the laying of the carcass reinforcement cords, and in document EP 0 264 600 for the laying of the rubber compositions. The tire may be moulded and vulcanised as set forth in US Patent 4,895,692.

According to this first example (Figure 1a), a first and a second reinforcement filament of carcass type 5 are arranged along the circumference of the tire so as to form a reinforcement structure which is partially toric or in the shape of an inverted U when observed along a section of the tire as in Figure 1a. Thus, each of the filaments extends transversely from one side of the tire to the other. In the different examples of Figures 1 to 10, this travel is extended from one bead to the other. The circumferential displacement of the filament between the cords of two adjacent groups is preferably provided in the radially innermost portion of the path; the filament is then turned up by substantially 180° so as to ascend the sidewall 3, cross the crown zone 2, then be extended radially towards the inside along the opposite sidewall, up to a radial position substantially symmetrical to that of the first sidewall. The filament is then turned up by substantially 180° in order to recommence a new path from one side to the other in similar fashion. The upturns form connections 11, advantageously in the form of a U, but possibly at a more acute angle or alternatively in a less regular form.

The first and second filaments are arranged circumferentially in similar manner, but in slightly offset circumferential positions, so as not to be superposed over great lengths. As illustrated in Figure 2, the filaments advantageously form groups 10 of filaments. In the example of Figure 2, these are groups of two filaments. A first "forward" section 14 enables the group to extend from the crown 2 towards one of the sidewalls 3. At the upturn zone, the two filaments of the group are turned up to form connections 11. These connections of several filaments produce crossings 12 of filaments. The group follows its trajectory towards the crown, forming a second "return" section 15.

Figure 1a shows a variant with a single reinforcement structure 5, whereas Figure 1b shows a variant comprising two structures, one an internal and the other an external structure, separated by a layer of rubber mix.

In each of the sections 14 and 15, the groups each comprise at least a portion of substantially parallel paths 16, in which the two adjacent filaments of one and the same group travel along substantially parallel trajectories.

Figure 2 illustrates an example of embodiment in which the portions of substantially parallel paths 16 are substantially included between the median portion 13 of the crown, along the line A-A, and the region of the shoulder 6, along the line B-B.

Figure 3 illustrates an example of embodiment in which the portions of substantially parallel paths 16 are substantially included between the median portion 13 of the crown, along the line A-A, and the region of the equator, along the line C-C.

In these two examples, the circumferential distance between two adjacent filaments or filaments of one and the same group 10 is less than the distance between two adjacent filaments each belonging to two distinct groups.

Due to the substantially radial trajectories of the cords, which in fact are similar to substantially meridian trajectories, for a given pitch P, the circumferential distance between two adjacent groups of cords varies substantially regularly between the bottom zone and the region of the crown of the tire. Most frequently, due to the lesser radius in the bottom zone of the tire, the filaments there are closer to each other. As the crown is approached, the radius becomes larger and the filaments then have more circumferential space between them. Figures 2 to 7 clearly show this context since these are projections in the plane of arrangements which are intended to occupy a spatial position such that the crown zone is on a first radius R and the zone of the bead 4 is positioned on another radius r which is smaller than the first radius R. The substantially toric form of a tire makes this type of

variation of radius inevitable. It is therefore unthinkable in practice to have a constant inter-cord distance between R and r.

The present invention goes against this teaching since the distance between two cords is maintained over a given portion, forming groups. In return, the distance between the cords of two adjacent groups varies substantially between the radial positions R and r so as to compensate for the parallel portions of the groups.

Industrial production rates and productivity constraints are nowadays such that very high manufacturing speeds are required and mean that the regularity of laying is not absolute. The mechanical demands of the product furthermore tolerate a certain margin as far as accuracy is concerned, without in any way adversely affecting the final quality. Thus, according to the invention, a tire may comprise cord arrangements having cord trajectories, the regularity of which is not as absolute as that illustrated in the figures.

Figure 4 shows another example of embodiment in which the circumferential distance between two adjacent filaments or filaments of one and the same group is greater than the distance between two adjacent filaments each belonging to two adjacent groups. In order better to visualise the effect created by this type of configuration, Figure 5 illustrates an arrangement similar to that of Figure 4, but in a partial, enlarged view.

Figures 6 and 7 illustrate another example of embodiment in which one of the cords of a group (in the case of a group of two cords) comprises a free end 17 located in the region of the bead. Figure 6 shows the travel from one bead to the other, whereas Figure 7 illustrates an enlarged portion of the travel on a single side of the tire. In the example illustrated, the free end 17 is extended substantially radially internally beyond the connection 11 of the adjacent cord. According to this embodiment, only one of the cords of a group of two comprises a connection 11 joining a forward portion 14 of a cord to the return portion 15 of this same cord. According to various variants (not shown), the free end 17 adopts other non-radial forms, for example comprising curved portions. The radial

position of the end may also vary, for example to be located radially externally relative to the connection 11. The free end is made, for example, by cutting one of the cords of the group upon laying, or alternatively, by replacing the continuous cord with a series of cords the length of which corresponds substantially to the trajectory from one bead of the tire to the other.

Figures 8 to 10 illustrate various examples of embodiment in which groups of cords are arranged along different paths of bias type.

Figure 8 shows a side view of a variant in which each group 10 comprises three cords 5 along paths of bias type (non-radial). The portions of substantially parallel paths 16 may extend substantially from one bead to the other. The compensation of dimension in order to pass from the lower radius r to the external radius R takes place owing to an increasing inter-group distance from the bead towards the crown. According to various variants (not shown), the number of cords per group may be different, for example two cords, four cords or more.

Figure 9 illustrates another type of configuration of bias type, in which the groups 10, after a first "forward" section 14 from the crown 2 towards a first bead 4 at a given angle ø relative to a substantially radial straight line, form an upturn or connection 11 to return towards the crown. When measured at the same radial position as the angle ø of the "forward" section, the "return" section 15 forms an inverse angle (-ø) compared with the "forward" section. The angle ø may vary for example between 5 and 45 degrees, according to the case. The left-hand portion of Figure 9 clearly illustrates an example of the path of a group 10 which has been isolated from the others in order to facilitate comprehension. The right-hand portion of the same figure illustrates the resulting arrangement when the groups 10 constituting the reinforcement structure are arranged side by side in the circumferential direction. On this portion, it can be seen that the "return" sections form a woven or grid pattern by passing above or below the "forward" sections. Such a woven or mesh pattern provides particularly advantageous mechanical properties. For example:

- reduction in the thickness of the structure of the reinforcement (less mass),

- the cables are closer to each other (slightly greater stiffness, less compression of the inner (towards the core) ply (or cords) upon the flexing caused by travel).
- A single manufacturing step for laying the cords at the positive and negative angles.

Figure 10a illustrates another variant of configuration of bias type in which groups of two cords 5 follow substantially geodesic paths. The connections 11 occupy either similar radial positions, or alternatively slightly offset positions. Depending on the laying process used, the latter configuration may possibly have several advantages. Thus, for example, if the two cords of the group are laid simultaneously, it is possible to pass around a single fixing point located substantially between the two connections 11.

In the examples illustrated in Figures 8 to 10, the groups of cords 5 comprise portions 16 of substantially parallel paths extending substantially from one bead of the tire to the other. According to various variants (not shown), these portions 16 may be limited, for example from one equator to the other, or from any point of a first sidewall towards a symmetrical point on the other sidewall.

Figures 11a, 11b and 11c are meridian profiles of a variant comprising a conventional bead wire 20, for example formed of a metal or composite cable. In 11a, the cords 5 can be seen travelling along a central core against which the various constituent elements of the tire are applied in succession. The cord travels from one bead 4 to the other and is extended radially internally relative to the bead wire 20. The arrangements of the cords 5 in groups 10, in "forward" 14 and "return" 15 portions forming connections 11 and crossings 12 at the level of the beads may, at this stage of manufacture, be comparable or similar to those shown in Figures 1 to 10. Thus, the connections and crossings 11 and 12 may be located radially internally to the bead wire 20.

In 11b, there can be seen the upturn of the cord 5, first of all against the radially inner portion of the bead wire 20, then against the axially outer portion of this bead

wire, in order substantially to surround or envelop the latter. The upturned portion 22 advantageously comprises the connections and crossings 11 and 12.

As shown in Figure 11c, the remaining elements constituting the tire are then applied so as to form a tire 1 according to the invention and the central core may be withdrawn, preferably after vulcanisation.

Figure 12a illustrates a perspective view of the form of embodiment shown in Figure 3. In addition to the elements previously described, Figure 12a shows a portion of a layer or crown ply 40, extending circumferentially over a portion of the crown 2 of the tire. Such a ply advantageously comprises at least one type of reinforcement, for example of textile type, arranged in the ply in an arrangement substantially at 0° in the circumferential direction or alternatively at a given angle, fixed or variable, relative to this same direction. A tread 42 and a layer for protecting the sidewalls 41 finish off the product. According to various variants, provision may be made, for example, for two angled plies possibly with a metal reinforcement. The crown ply (plies) may also be laid before the carcass cords (or radially internally), or in a wide variety of "sandwiches" with the interpolated or interlaced carcass plies and crown plies.

Figures 12b and 12c illustrate variants of Figure 12a in which examples of anchoring of the reinforcement structure in the beads are illustrated. In 12b, the anchoring zone 43 is applied against the base of the cords 5, preferably leaving a layer of rubber mix between the cords 5 and the cord(s) of the anchoring zone. The anchoring zone is preferably as previously described. A sandwich arrangement, such as in Figure 1a, with stacks on each side of the reinforcement structure may also be provided. The variant of Figure 12c comprises an interlaced zone 44 between the bases of the reinforcement structure. The bottom or radially inner portion of a section comprises in alternation a first set of connections 11 and crossings 12 arranged axially externally relative to the zone 44 and another set of connections 11 and crossings 12 arranged axially internally relative to the zone 44. This axial separation makes it possible to place a larger number of cords even when the radius is small. The mechanical properties such as rigidity may also be

optimised. As illustrated in 12c, in this variant, the "forward" 14 and "return" 15 portions of a group of cords 15 are advantageously spaced and separated by at least one "forward" and/or "return" portion of another group of cords.

Figures 13a to 13d illustrate an example of a method which permits the manufacture of tires such as those described in the preceding figures, with the substantially simultaneous laying of at least two cords 50. Using this method facilitates obtaining portions of substantially parallel paths such as previously described. Storage or supply means enable two, three (or even more) cords capable of being applied to a first layer of rubber mix formed substantially in the image of the profile of the final product to be brought in. Before application, the cords are arranged in the immediate vicinity of each other at distances corresponding substantially to the distance provided between the cords of one and the same group. For application of the cords against the mix, the laying means moves in space, for example from one bead to the other, along the path which the cords to be laid have to follow in the tire.

Thus, a group of cords is guided by a laying means for application along a predefined path. The laying may be effected either by guiding the group to a substantially infinitesimal distance from the product intended to receive the cords, either by compaction or by application of a laying force by means of a suitable tool until it comes into contact with the rubber mix previously applied. This mix is preferably adhesive, thus enabling the group of cords to be retained or held in place once slight contact is produced between the cords and the rubber mix. The group is therefore guided from one bead of the tire to the other, travelling over the sidewalls and the crown. Once laid as far as a radially lower portion of a bead, thus forming a "forward" section, the group of cords is guided so as to move circumferentially or angularly, to enable the group of cords to move over the profile in a path substantially adjacent to the "forward" portion to form a "return" section, extending as far as the opposite bead.

Figures 13a to 13d diagrammatically illustrate a mechanism which makes it possible to lay groups of cords such as described above. Reserves 60 of cords

enable the laying mechanism to be supplied. The latter comprises a series of guide means 53, 54 (preferably as many means as there are cords to be laid), which are preferably mobile from one side of the tire to the other, actuated by a control means 50, 51, 52. In the example illustrated, the control means comprises a motor 50 and transport elements 51 and 52, such as, for example, a slider which moves on a rail, enabling the guide means 53, 54 for the cords 5 grouped for example in twos or threes (as illustrated) to be moved in space. Figure 13a illustrates an example of displacement of the guide means of one side of the tire. Guiding as close as possible of the profile as far as the level of the bead makes it possible to effect advantageously precise, regular laying. The guide means bring the cords into the bottom position; a relative angular displacement between the guides 54 and the tire being assembled makes it possible to move the cords in translation to form the connections 11. In order to do this, either the tire undergoes rotation by several degrees, or the guide 54 moves along the bottom zone, or a combination of the two. According to an advantageous variant, such as illustrated, a press element 55 exerts a slight pressure against the base of the cords before shaping the connections. Thus any accidental sliding or displacement of cords during laying is avoided.

Figure 13b shows the development of the path several moments later, when a connection has been produced, the guide 54 re-ascends along the sidewall in order to lay another section, circumferentially spaced apart from the previous one.

Figure 13c illustrates the same tire, when the slider arrives from the opposite side; the guide 54 carries the cords into the region of the shoulder. The laying along the opposite sidewall and the production of the corresponding connections is effected similarly to that previously described for the first sidewall.
Figure 13d illustrates the return of the slider 51 and guide means in order to produce a new "forward" section.

According to an advantageous variant, the distance between the cords before laying is variable or adjustable, so to as make it possible to lay the cords with larger or smaller inter-cord spaces depending on the types of products, or even

with variable spaces on one and the same product, for example as a function of the position on the profile.